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FRIDAY, MARCH 23, 1883.

THE SPHERE OF THE UNITED STATES GEOLOGICAL SURVEY.

EVER since the establishment of the U. S. geological survey, in 1879, there has been a question as to the extent of the territory subject to its researches. The legislators who framed the organic law intended to make the field of investigation co-extensive with the United States; but they failed to employ unmistakable language; and the officer on whom devolved the interpretation of the law construed 'national domain' to mean only those states and territories in which are public lands. It seemed to those interested in the work, that this restriction was unwise; and a resolution to remove it was introduced in the next Congress. The House acceded without a dissenting voice, but in the Senate the cry was raised that state rights were being invaded. A political discussion ensued, and the proposition failed to reach a vote. In 1882, however, the paragraph appropriating money for the survey was so altered as to extend its operations to the whole country; at least, so far as is necessary for the preparation of a general geological map.

Under the authority thus granted, several new works have been initiated, and two investigations already begun have been carried into new territory. Of the new undertakings, the most important are geographic. Three topographic parties and one triangulation party were sent to the Appalachian mountains in North Carolina, and adjacent portions of Tennessee, Kentucky, Virginia, and West Virginia; and a base-line was measured in Arkansas as a first step toward the mapping of the Ozark mountains. An investigation of the mesozoic strata of eastern Virginia, North Carolina, and Maryland, already begun by Prof. William M. Fontaine, was taken up by the survey; and a beginning was made in the study of the Orange Sand of the Gulf States. The works previously instituted, but now extended to new ground, were the study of the northern drift, by Prof. T. C. Chamberlin, and

the study of the copper-bearing rocks of the Lake Superior region, by Prof. R. D. Irving.

The temporary restriction to which the survey was subjected led to a free discussion, not only of the constitutional competence of the nation to investigate the mineral resources of the states, but of the proper functions of a scientific survey endowed by the government, and of the relative functions of national and state geological surveys. The fact was developed, that the directors of the existing state surveys, almost without exception, favored the establishment of a national survey, but that the wisdom of the measure was questioned by several geologists not directly connected with state work. The chief ground of objection appeared to be, that the local interest essential to thorough local work could be best secured by local organizations; the chief ground of support, that the work in each state must develop scientific problems soluble only by investigations carried beyond the lines of the state. Those who recognize both these considerations hope that the inauguration of the national work will not be followed by any abatement of state work. Certainly there is ample room for both; and a national survey is no more competent to discuss local questions than are state surveys to answer those of a general nature. With a proper differentiation of function, there need be no more overlapping of work than is necessary to promote salutary discussion. So far as indicated by its initial work, the national survey purposes to confine its attention to researches the subjects of which lie in several states, and the results of which have more than a local interest. Professor Irving's investigation of the copper-bearing rocks leads him, of necessity, into three states; and Professor Chamberlin's study of the great moraine marking the second division of the glacial epoch, has carried him and his assistants into thirteen states and one territory. The scientific value of a national organization is especially illustrated by the latter work. While Professor Chamberlin has had the advantage of a great body of published material, he nevertheless owes to the U. S. survey the opportunity of tracing, and uniting

into one continuous chain, some three thousand miles of terminal moraine. If this comprehensive view had been possible to some geologist twenty years ago, how different might be the literature of our drift!

IMPROVEMENT OF THE NATIVE PASTURE-LANDS OF THE FAR WEST.

It is a well-known fact, that the greater part of the United States west of the meridian of Omaha is unfit for tillage. Here and there, there are strips of land, which have a larger rainfall, that may be brought under the plough; and along the rivers there are narrow belts of land that may be made tillable by irrigation. A portion of this region is utterly barren; but a large part of it — probably not far from one million square miles of the whole area, or an area nearly one hundred times the surface of Massachusetts — bears a scanty crop of grasses. The natural use of this region is already recognized: its sole worth is for the pasturage of cattle and sheep. Already a great herding industry has been created in this region, — one that has an important bearing on the food-supply of this country and of Europe. The only limitation on the great extension of this industry is found in the scantiness of the herbage and the inadequacy of the water-supply. The latter evil is probably remediable, in most cases at least, by wells or by storage-reservoirs, which shall retain the abundant waterfall of the rainy season. I propose to offer some suggestions concerning the possibility of bettering the herbage of forage-plants.

All the grasses that now grow in that region make but a scanty herbage. I am informed by stock-raisers, that the best 'ranges' require from fifteen to twenty acres to a head of horned cattle, and that from this unusual goodness the 'ranges' decline in value, until, in many districts, a hundred acres is required to supply a beast. The wide extent of the ranges necessary to afford pasturage to herds of profitable numbers makes the supply of water more difficult than it otherwise would be.

It seems to me possible that the pasturage of this region might be materially improved by the introduction of grasses and other forage-plants indigenous to regions having something like the same conditions of climate. My reason for hope in this matter are substantially as follows: the experience of settlement in this country shows that the grasses are more easily feralized than any other of our domesticated plants; several of them show a

willingness to escape to the wilderness; so that there is hope that a careful selection in various lands might afford some other species that would run wild on our dry plains and mountains. European experiments in naturalizing grasses have been fairly successful, as in the case of grasses to protect dunes from the action of the wind.

There are many regions in the world where grasses have developed to suit just such conditions as we have on our plains; and in some of those regions the period for the process of development to go on has been far longer than in North America. In North America it has been but a single geological period since the vegetation of the plains and Rocky Mountains was well watered; while in Australia it seems likely that the dryness of the climate has been in existence from a rather remote past. The same is probably the case in the northern parts of Asia and in South Africa. Good effects from the introduction of foreign forage-plants may be hoped for, if the only result were an increase in the variety of the herbage on the plains. With the poorest grasses there are generally wide interspaces between the tussocks of high-growing species. If these intervals could be filled with other forage-plants, the consequence would be a greater amount of food to the acre.

In the effort to naturalize foreign species of forage-plants, attention should be paid to all forms of plants that can afford pasturage or browsing. There are many forms that would be likely to do well along the streams, that might not succeed so well in the open country.

The regions that are likely to furnish plants calculated to flourish in a region of low rainfall include a large part of the earth's surface. Those that would succeed in Dakota are not likely to do well in Texas or Arizona. For the northern region, the uplands of northern Asia or of Patagonia are the most promising fields of search; while, for the middle and southern fields, the valley of the La Plata, southern Africa, Australia, and the Algerian district, may be looked to for suitable species.

The experiment is naturally one for the federal government to undertake, but it need not be costly. Three experimental stations — one in the northern part of Nebraska, one in Texas, and one in Arizona — would serve the needs of a thorough trial. Ten thousand dollars per annum at each station should meet all the expenses of a sufficient trial; at least, until it was proven that the experiment would be successful. If we add the expenses of a travelling student of wild forage-plants (perhaps